DCCUMENT RESUME

ED 049 534 EA 003 406

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TITLE Analysis of Educaticnal Programs.
REPORT NO P-4576
PUE LATE Mar 71
NOTE 18p.; Paper presented at American Educational Research Asscciatien Annual Meeting. (55th, New York, New York, February 4-7, 1971)

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS *Cost Effectiveness, Educational Planning, Program Budgeting, Program Costs, Program Effectiveness, Program Evaluation, *Program Planning, Resource Allocations, *Speeches, *Systems Analysis, *Systems Approach

ABSTRACT

This conference paper discusses the role of the Planning, Programing, and Budgeting System (PPBS) in planning for educational programs. Proper PPBS analysis includes (1) correct problem definition, (2) consideration of alternative solutions, (3) ascertainment of peripheral effects of the alternatives, and (4) estimations of the cost and effectiveness of the alternatives throughout the probable life of the program. A PPBS analyzer should have (1) thorough knowledge of the educational system and an appreciation for the complex interactions among various parts of the system, and (2) a rational, objective, intellectual approach with a large measure of common sense. (Author/LLR)

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ANALYSIS OF EDUCATIONAL PROGRAMS

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In a Planning, Programming, and Budgeting System, the Program Structure summarizes the overall objectives of the school system. These objectives are extrainstitutional in character; that is, they express what the schools are trying to accomplish for their clients--their students and the community that supports them. (Presumably, if these objectives adequately express the needs and desires of the clients, efforts directed merely to keeping the system alive can be minimized.) At the same time, it must be possible to identify the resources and activities that the school system provides with the primary aim of attaining each objective--that is, to group resources and activities "by objective" in the Program Structure. Thus, such objectives must be more highly aggregated than the usual *behavioral objectives*, to which it would be burdensome indeed to assign resources and activities. In addition, the resulting data would be too detailed and too massive to provide the information needed for making decisions at the higher administrative levels where programs and program elements are of concern. (A program or program element is a system of resources and processes that produce something of use outside the program. A *behavioral objective* is a subobjective within a program element.)**

The process of analysis within a Planning, Programming, and Budgeting System generates information that describes educational programs.

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This is the text of a talk presented at the AERA Annual Meeting, February 4, 1971, in New York City.

**For a more detailed discussion of these points, see *Program Budgeting for School District Planning: Concepts and Applications*, S. A. Haggart, et al., The Rand Corporation, RM-6116-RC, November 1969 (especially Ch. II).

This information serves two major purposes. The most fundamental is to describe on-going programs--what they are, what resources they require, and what is their effectiveness. The second purpose served is to facilitate rational comparisons of alternative ways to conduct educational programs.

A key aspect of the analysis required to describe on-going programs is a description of what the program actually is--what people, facilities, equipment, and materials are really used and *how* they are used to attain the objectives. The process is analogous to determining actual class size in a given school by gathering data on the number of students in the classes of interest rather than by using some average pupil-teacher ratio for the school or the district. Without this kind of detailed, knowledgeable analysis, a Program Budget is merely a reorganization of the usual budgetary figures; such a budget can easily be misleading because it appears to present relationships between resource use and effectiveness that may not exist.

If the Program Budget realistically describes the resources required by existing programs and their effectiveness, it can be invaluable in helping administrators and other decisionmakers to decide how to allocate resources among programs. This can result in a better alignment with the decisionmakers' judgment as to the proper emphasis for the particular student population and community. (For example, in poorer neighborhoods, reading and vocational education might be more heavily emphasized than in neighborhoods that are more well-to-do.)

In addition, in the process of formulating the descriptions of the programs, data will be generated that will suggest *how* resources may be shifted from one program to another. Such shifts will be necessary if a fixed overall budgetary level must be maintained and if a desired improvement in the effectiveness of a program demands additional resources. In this sense, programs "compete" for resources. For example, if additional emphasis is needed in the reading program, there should be data that show how much money can be saved by cutting down, say, certain extracurricular activities and that estimate what this money can buy in terms of increased resources devoted to reading.

On the other hand, programs may reinforce one another. The reading program may bolster student work in other academic areas, the student

health program may contribute to improved student performance in class and in sports, and counseling and guidance may improve the students' motivation and thereby their performance in all school activities. In general, the relationships among program resources are much easier to estimate than are relationships among program effectiveness. Experimental evidence may be needed to substantiate the latter and should be obtained wherever possible so that the effect of shifts in the effectiveness of one program on the effectiveness of others can be considered when decisions must be made.

In addition to providing data and information describing on-going programs, the analytical approach required by a Program Budgeting System can supply the means to compare alternative ways to meet the objectives of a single program. This is the major function of the analytical effort. In this role, the analysis can:

- Help assess the relative worth of several innovative approaches to attaining the same educational outcome (such as improvement in reading achievement)
- Determine whether a single program is becoming more or less effective or costly as time passes so that steps may be taken to improve it, if necessary
- Help assess the relative worth of the same program for different student populations or in different school settings.

The goal of the analysis is not to provide the planner with the alternative that "maximizes" or "minimizes" specific characteristics; the goal is to provide information to which the planner can apply his judgment in order to choose the alternative that best meets his needs within his constraints, such as budget level or community pressures.

The analysis of the resource requirements, cost, and effectiveness of on-going programs is the base upon which the Program Budgeting System must be built. Decisions concerning desirable shifts in resources among programs will be supported by this analysis but must, ultimately, represent the decisionmakers' subjective value judgments concerning the desirable emphasis among programs. More rigorous analysis can be applied to alternatives for the same program, however, because here the educational outcomes are more directly comparable. This latter type of

analysis is usually oriented to specific educational problems such as improvement in academic achievement in a particular area or dropout prevention.

Two steps are crucial to good analysis directed toward assisting in the choice among alternatives: (1) problem definition and (2) definition of alternative means for solution. (See the shaded areas of Fig. 1.) Obviously, the right solution to the wrong problem is of little value. For example, for a long time the prevention of dropout from junior high and high schools was seen as a major problem in public education. A possible solution to this problem could be to rigorously enforce school attendance laws and to turn guidance and counseling services into antidropout squads. More recently, however, there has been a growing awareness that school dropout may be a symptom of a more serious problem, a lack of perception of the value of staying in school, which may itself stem from a true lack of return to the dropout population for completed schooling. Thus, a mere decrease in dropout may not represent a true gain either for the students or the schools.

The second requirement for good analysis is for the definition of alternative means for solution to the problem (A1, A2, etc., on Fig. 1). The proposal of a single solution for a problem in education is rarely sufficient because:

- A single solution gives the decisionmaker no feeling for whether he could do better or worse in some other way; the analysis takes on the aspect of a "sales pitch"
- A single solution gives the decisionmaker no opportunity to exercise his judgment as to the relative worth of various aspects of the proposal
- A single solution is less likely to uncover additional features that the decisionmaker had not thought of but would find desirable.

To make this thesis a little less abstract, consider the process of shopping for an automobile. If only one car existed within each price range, the buyer would have to be satisfied with the manufacturer's judgment as to the relative worth of styling, economical operation, high performance, safety features, and so on. But the existence of several cars,

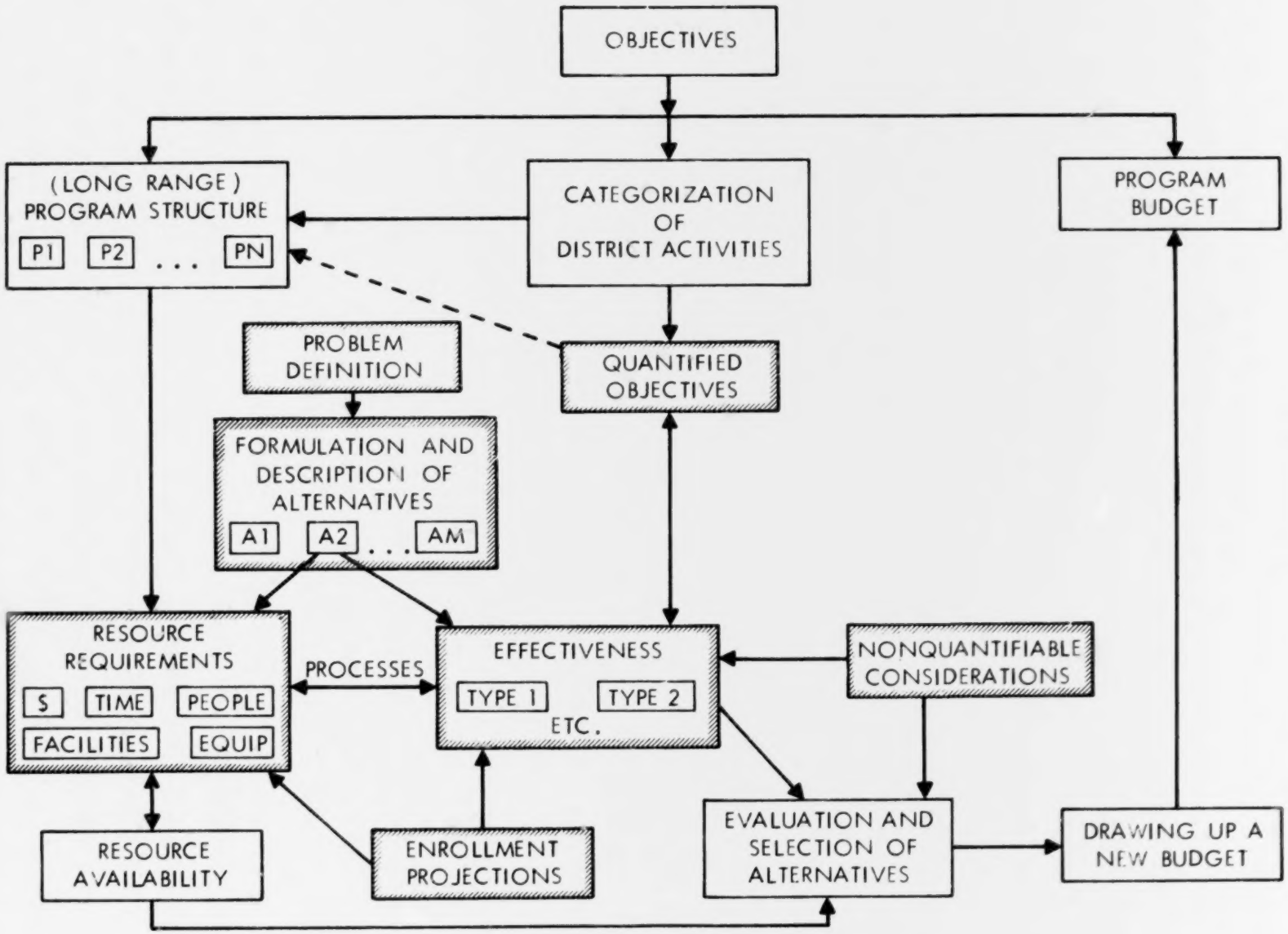

Fig. 1—Analytical activities in a PPB system

each of which may fall within what the buyer can afford and each of which represents a different balance among characteristics, permits the buyer to choose that car which best fits his value structure. In addition, the descriptions of the different cars may suggest features (desirable or undesirable) that the buyer had not thought of before he started shopping.

I submit that "shopping" for educational programs is at least as complex as shopping for automobiles. And because of the complexity of problems in education, it is naive to try to provide the decisionmaker with *the* solution that maximizes or minimizes some aspect of crucial concern. In fact, most currently fashionable formulas for the cost-effectiveness of educational programs are quite frankly window-dressing and have little relationship to the programs they purport to describe. (I even saw one for the cost-per-pupil to attain a year's growth in reading that was projected backwards from 1 year's data to describe the past 10 years. Worse, the black students who were having difficulty in reading had been in the system for only 2 of those 10 years.)

Returning to the shaded areas of Fig. 1, note that the analysis of alternatives requires descriptions of their resource requirements, their effectiveness, and the processes that relate the two aspects. The nonquantifiable considerations include not only those aspects of effectiveness (such as improved community relations) that are difficult to measure, but also the value judgments that apply relative rankings to all aspects of effectiveness, quantifiable and nonquantifiable.

Now let us leave this rather general discussion to consider an example, drawn from an actual situation but considerably reworked for the purposes of this paper. The problem was that a large population of Mexican-American students at the junior high level were "underachieving" in reading and arithmetic. One particular solution was proposed and implemented. It was a combination of the alternatives that I shall describe and that I shall hypothesize were also implemented, for the sake of illustration.

The actual project had three parts: remedial reading and math, the study of occupational technology, and the involvement of parents and students in special activities. I shall describe each of these briefly.

The subject-matter content of the remedial reading and math was not changed from that of the standard 8th grade curriculum. Each was given during one of two periods to classes of 15 students each, approximately half of the size of a normal class. A diagnostic/prescriptive approach was used. Initial diagnosis of reading difficulties was made by means of the Durrell reading test, and of math from the profiles of the students' performance on subtests of the California Achievement Test in math.

Occupational technology was taught through a variety of means. In the classroom, gaming and simulation were used with groups of approximately 15 students each. This activity was geared to the reading and math curricula and took one period every day. The gaming/simulation activity, which is how I shall refer to this from now on, was a highly structured representation of real-world situations. Students played the roles of actual people, such as a park director or a highway engineer. Each unit was supplemented by a study trip to a facility directly related to classroom work. There were about 19 study trips throughout the year. Students helped to make the arrangements for the study trips by use of a conference phone.

The third component was the involvement of parents and students in special activities, which I shall refer to as *involvement* from here on. For involvement of the students, there were two study trips of 4 days each. For example, one trip was to a beautiful park on the seashore; another went to a park in forested mountains. These study trips were again very highly structured. They were intended to break down the stereotyped roles of students and teachers in the classroom and to involve students in a prolonged and intensive learning experience. It was apparent that they accomplished both of these goals. College students were used as team leaders for the learning activities.

The parents of the students in the program were also involved. Before school opened, they were asked to attend a preschool dinner, where they were told what the program was to be about and where their consent was sought for the students to participate in the program in general and in the intensive involvement trips in particular. In addition, the parents were invited to all of the study trips that accompanied the

gaming/simulation activity, to the intensive involvement trips, and to several other dinner meetings throughout the year. At every one of these activities the parents participated along with the students and teachers. For example, they played some of the games during the dinner meetings, and whereas the students taught their parents at the beginning, the parents took great pride in teaching their children toward the end of the sessions. Finally, the teachers made home visits to all of the parents during the course of the year to discuss some activity connected with their children's participation in the program. This assured that each visit had a clear purpose so that the parents were at their ease.

Figure 2 displays what the long-term effects of the program might be on achievement in reading if it were continued. Normal growth, which is represented by the dashed line, would be indicated if a student was achieving at the 5th-grade level in the 5th grade, at the 6th-grade level in the 6th grade, and so forth. An approximation to the rate of growth for Mexican-American students (Coleman, et al., 1966) is shown by the solid line. Because the Coleman report gave reading achievement levels only for the 6th, 9th, and 12th grades, the growth rate by grade can be inferred only very roughly, as indicated.

The experimental program was intended to raise the growth rate at least to normal and, ideally, to provide sufficient initial growth that the student could make up for prior years of underachievement. The program succeeded in the 8th grade in raising the students' growth rate to 1.8 months per month, as represented by the sharp peak, while in the 9th grade the growth rate was 1.1 months per month. Students have continued to show normal growth, as suggested.

Another aspect of effectiveness is the effect of changes in one achievement measure on other measures not affected by the program directly. Logically, one might think that if a student's performance in reading has been improved, his performance in other subjects would also improve, particularly those such as science that require reading skills. Therefore, perhaps the program also raised the students' achievement in science above normal growth, as suggested by the hypothetical upper dash-dot line on Fig. 3. But it is also quite possible that the science program suffered by comparison with the experimental activities. In that

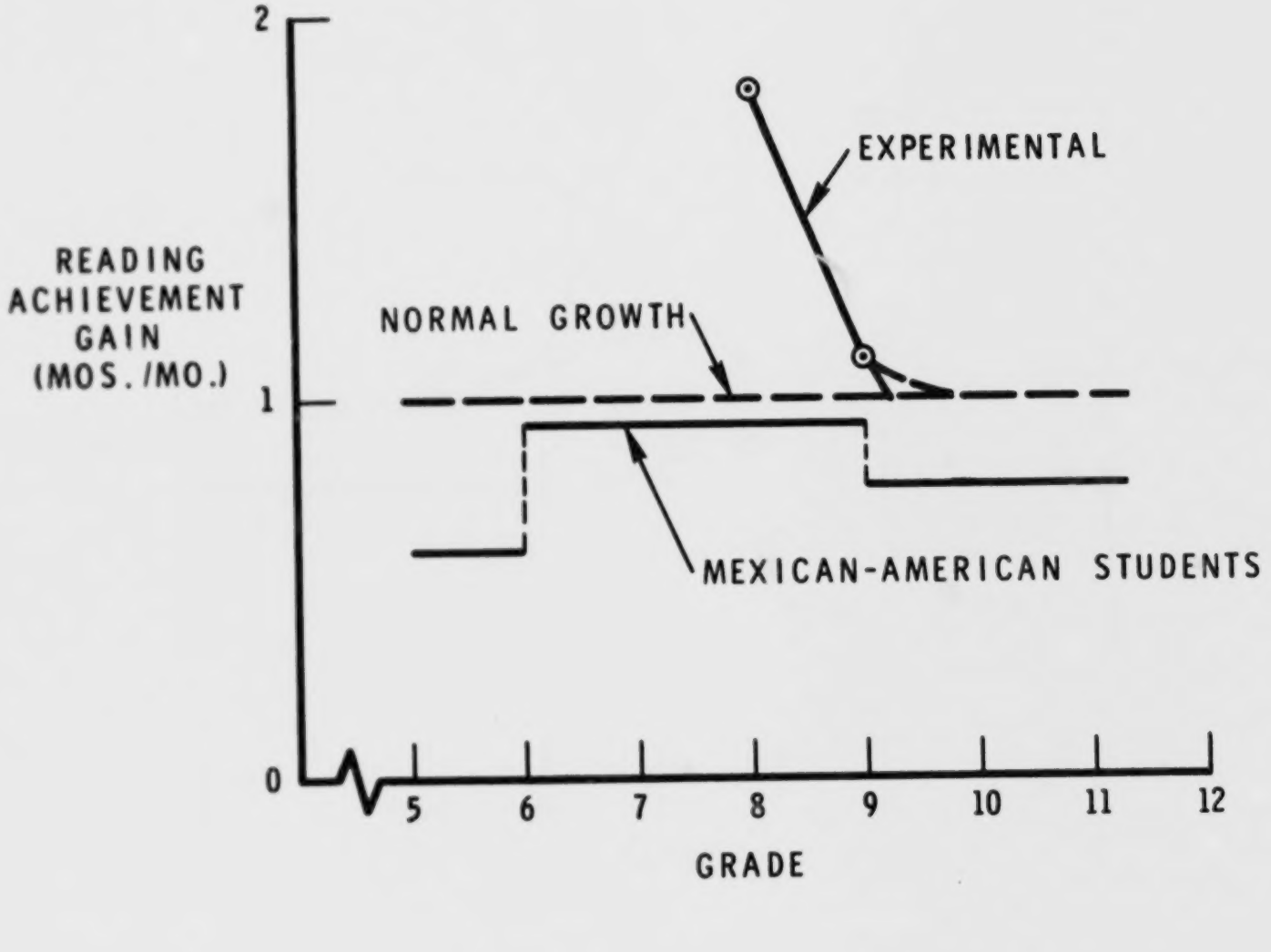

Fig. 2—Long-term growth in reading achievement for experimental program

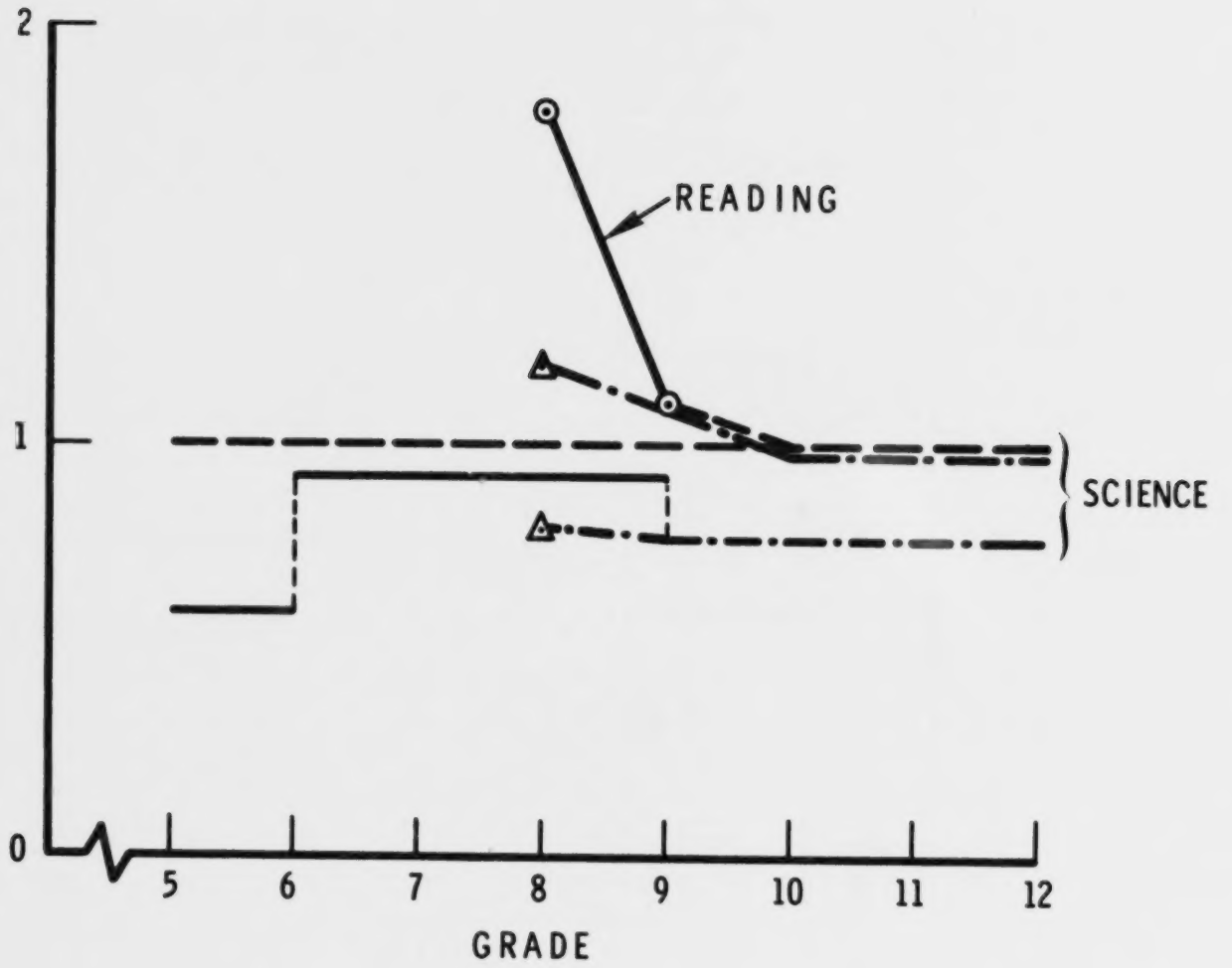

Fig.3—Effects of reading achievement gains on achievement in science

case, the students' performance in science may even have dropped below the normally low achievement for this population. Thus, we must measure the students' achievement in *all* areas of interest so that we will know what the indirect effects are, if any.

For the purposes of illustration, various combinations of the three components I described--the remedial reading and math, the gaming/simulation, and the involvement--were formed, and the cost of each combination for various numbers of students was estimated (Carpenter and Haggart, September 1969). In this way, we derived what we term "equal-cost alternatives," that is, alternative programs that cost very nearly the same. Each alternative differs from the others in terms of numbers of students involved and probably in achievement growth.* These differences are illustrated on Fig. 4. For example, although the gaming/simulation activity might not induce as much achievement gain as would the total program, it could be provided to five times as many students. It might, however, be too close to the dashed line--indicating 1 month per month, or normal growth. The dashed line is critical because the State of California considers any achievement growth less than this to be unacceptable. This would mean that, although the involvement could be given to 90 children for an equal cost, it would not be acceptable if the achievement it induced fell below the critical minimum, as suggested. If the district is not required to meet a minimum standard in achievement gain, it will be possible to trade off achievement gain on the one hand and the number of students reached on the other. This might be an important consideration if the schools need visibility. In that case the gaming/simulation would always be the best choice, because it is the least expensive per student.

The other two alternatives shown may more than meet the minimum requirement so that the choice between them would depend on whether one felt it more important to provide a higher rate of achievement to fewer students or a lower rate of achievement to more students. Because the remedial reading and math program is not particularly innovative, one

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*We estimated the relative contributions to achievement growth by each of the three components after discussing the question with students, teachers, and program directors. No direct measures are available.

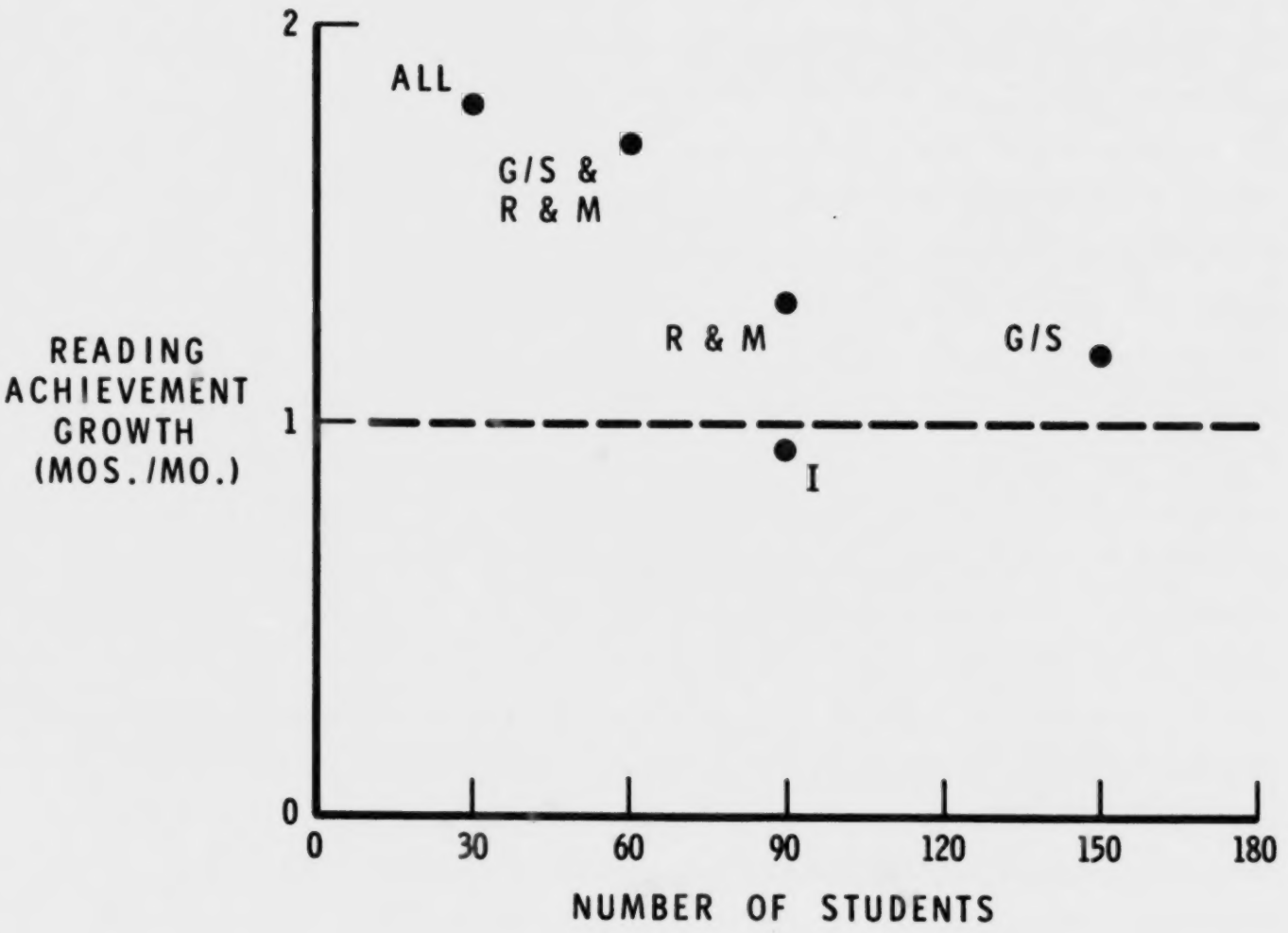

Fig. 4—Effectiveness of alternatives

might be more interested in the gaming/simulation plus reading and math, even though it can be given to only 60 students.

Now let us include another measure of effectiveness in our analysis. Two measures of effectiveness--one, growth rate in reading, and the other, an index of attitude change for each program--are plotted against number of students on Fig. 5. This index was derived by assuming that each alternative would induce a change in attitude relative to the change induced by the original program. (These estimates were derived from subjective opinions of people involved with the program.) Thus, the index of attitude change for the original program is unity, and the other alternatives have indices less than this.* As before, gaming/simulation alone looks risky because it is not being reinforced with backup programs. In addition, it may induce relatively little attitude change; reading and math look even poorer in this regard, while the involvement is too low on achievement gains. Note how the addition of the second measure supports the superiority of the combination of reading and math with gaming/simulation over reading and math alone. Thus, we may want to accept smaller numbers of students and have reinforcing programs, as in the gaming/simulation and reading and math, where we buy achievement gain and attitude change for 60 students, or we may prefer to buy less of each for 150 students with the gaming/simulation alone. Which one a decisionmaker chooses will depend upon whether he considers gains per student or numbers of students reached more important.

I should like to use the hypothetical example just presented to illustrate some of the features of a good analysis within a Program Budgeting System. First, although the problem was defined by the State of California to be underachievement in reading and arithmetic, the

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*A slight digression at this point will help to explain the rationale behind this figure. Analysts have a tendency to lump all measurables in single indices for the sake of simplicity of manipulation and presentation. For example, the number of students in each alternative program might have been included in the indices. Although this would have made for a very pretty picture, it would have been almost impossible to interpret because too many variables would be combined in a single point. As far as possible, it is better to keep measures that are significant in their own right separate.

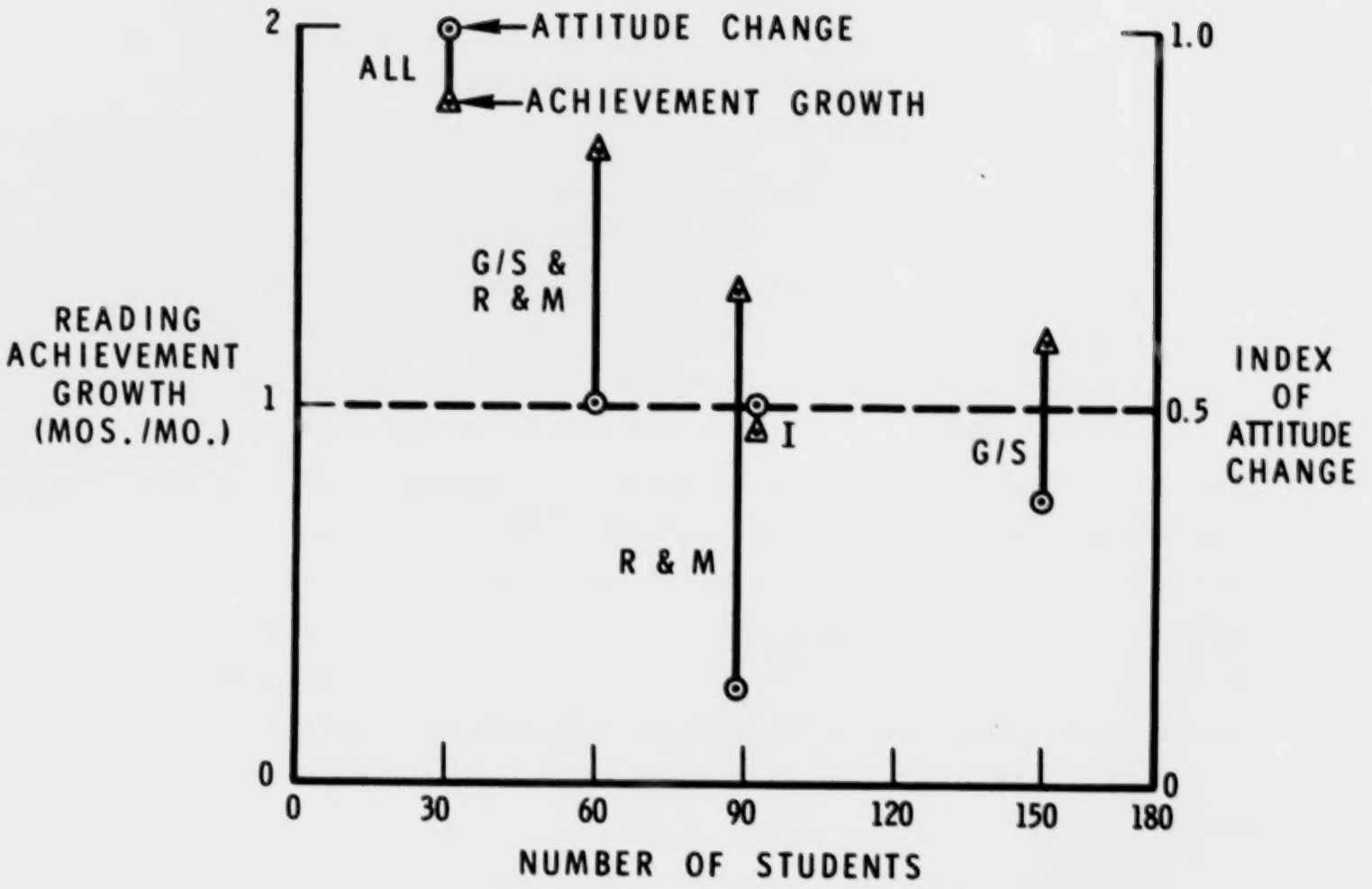

Fig.5—Three measures of effectiveness

designers of the experimental program recognized that the underlying cause might be ignorance in the Mexican-American community of the role that these subjects play in the world of work. *Correct problem definition* was, therefore, attempted and most of the solutions attacked this basic difficulty.

Most of the other aspects of a good analysis, however, can be found only in the hypothetical example, not in the real program. I do not mean to level any special criticism at the program used for analysis in this paper, however; this situation is almost universal in education at the present time.

As discussed previously, the *consideration of alternative solutions* is essential to good analysis in education. These alternatives must be described with care and as they actually work in practice. Then their resource requirements and costs must be generated *from* the descriptions; that is, these data must be built from the bottom up, not from the top down. And, finally, some attempt should be made to find causal relationships between the resources and internal working of the alternatives and their effects.

Because educational activities are complex and are embedded in social structures in the school and community, an important aspect of any program is its effect on teachers, students, administrators, and others involved. In addition, the impacts of the program on other programs in the system should be assessed, whether they be resource impacts or changes in effectiveness. Thus, a good analysis gives concrete evidence that the *peripheral effects of the alternatives were ascertained* as well as possible.

The resource requirements and cost of a program over a period of several years should be estimated so that the effects of short-term requirements for special facilities and the like will be seen in perspective. The same holds true for considerations of effectiveness, which may be only temporary if the Hawthorne effect is responsible. Thus, a good analysis *estimates the cost and effectiveness of the alternatives throughout the probable life of the program.*

Now that I have discussed the characteristics of a good analysis, what are the characteristics of a good analyzer--one who can generate

the kinds of information needed? I would list two:

- o A thorough knowledge of the educational system and an appreciation for the complex interactions among the various parts of the system
- o A rational, objective, intellectual approach with a large measure of uncommon "common" sense

The possession of a kit of sophisticated analytical tools is of much less importance than these two characteristics. In fact, people who know how to use sophisticated techniques often tend to apply them whether or not they have anything to do with the problem at hand.

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